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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/086,620	02/28/2002	David B. Buehler	1027.2.1	1888

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EXAMINER	
NGUYEN, KIMBINH T	

ART UNIT	PAPER NUMBER
2671	6

DATE MAILED: 05/13/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/086,620	BUEHLER, DAVID B.	
	Examiner	Art Unit	
	Kimbinh T. Nguyen	2671	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01 March 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *14* is/are allowed.

6)☒ Claim(s) *1-5,11-13 and 15-24* is/are rejected.

7)☒ Claim(s) *6-10* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 5.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. This action is responsive to amendment filed 03/01/04.

2. Claims 1-24 are pending in the application.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-5, 12, 15, 17, 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lathrop (6,597,359).

Claim 1, Lathrop teaches a method of recursive ray casting (col. 1, lines 25-42; fig. 1), the method comprising: providing a ray bundle (rays 2, 6, 7, 8, 9, 11, 13; fig. 2) of a selected position, direction and size (col. 1, line 52 through col. 2, line 22; col. 4, lines 30-31); conducting a bundle proximity test (ray direction check) of a selected proximity at the selected position (col. 13, lines 29-47); and advancing the ray bundle a first casting distance (ray distance) when the proximity test is negative (col. 12, lines 44-58). Lathrop does not teach advancing the ray bundle; however, the ray bundle that is advance by the bundle caster corresponds to screen area or region within the graphical scene, this feature also taught by Lathrop (col. 13, lines 26-67). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to

apply the proximate test for provide advancing ray casting distance, because it would provide accelerated ray tracing which is needed for incorporating in hardware implementation that would provide fast and accurate image rendering (col. 3, lines 63-67).

Claims 2, 3, Lathrop discloses the first casting distance corresponds to the selected proximity (the scene volume represented by the node); the size of the ray bundle (the number of rays) corresponds to the selected proximity (col. 9, lines 12-16).

Claims 4, 5, Lathrop teaches advancing a second casting distance when the bundle proximity test is positive, retreating a second casting distance (find the ray distance) when the proximity test is positive (col. 12, lines 44 through col. 13, line 7).

Claim 12, Lathrop teaches accessing a distance grid (x distance; col. 15, lines 52-67).

Claim 15, the rationale provided in the rejection of claim 1 is incorporated herein.

Claim 17, Lathrop teaches the pixel set is defined by an area selected from a scan line span, a rectangle, and a triangle (col. 14, line 65 through col. 15, line 20).

Claims 20 and 21, Lathrop teaches a collision tester (intersection test) configured to receive a ray position and provide a second hit signal indicating whether the ray position is on or within the graphical object; a ray caster configured to advance the ray position (col. 2, lines 24-40).

5. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lathrop (6,597,359) in view of Kaufman et al. (5,442,733).

Claim 13, Kaufman teaches accessing a list of proximate objects (proximity indicator; col. 18, lines 36-41). It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the proximity indicator taught by Kaufman into ray tracing of Lathrop's system for accessing a list of proximate objects, because using proximity indicator, it would denote a nearness to a 3D object of the families of 3D discrete rays (col. 18, lines 37-40).

6. Claims 11 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lathrop (6,597,359) in view of Jennings, III (6,430,589).

Claim 11 and 19, Lathrop does not teach testing Boolean flags; however, Jennings, III teaches testing Boolean flags (fig. 8); the bundle caster comprises at least one register file, each register file thereof coupled to an ALU (col. 15, lines 16-24). It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the testing flag as taught by Jennings, III into the ray tracing of Lathrop's system, because it would provide an arithmetic engine for video frame rendering (col. 6, lines 57-60).

7. Claims 16, 18, 23 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lathrop (6,597,359) in view of Sowizral et al. (6,445,391) and Greene et al. (5,579,455).

Claim 16, Lathrop does not teach an occlusion detector; however, Sowizral et al. teaches an occlusion detector operably connected to the bundle caster (software occlusion culling; col. 1, lines 56-67), the occlusion detector configured to receive a pixel set descriptor and a minimum z-depth. It would have been obvious to one of

ordinary skill in the art at the time the invention was made to incorporate the occlusion detector taught by Sowizral into the ray tracing of Lathrop for visible object determination, because performing occlusion culling, it would improve rendering effectiveness, increase the graphic hardware's overall rendering bandwidth by not asking the hardware pipeline to draw occluded objects (col. 1, lines 58-60). Sowizral does not teach z-min; however, Greene et al. teaches x-min values is the nearest depth value in the covering depth element (col. 17, lines 36-40). It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the z buffer as taught by Greene into occlusion detector of Sowizral for providing the finest level in the covering depth element, because using z-min elements, it would permit a possible definitive determination of visibility (col. 17, lines 21-23). Further, **Claim 18**, Sowizral teaches the occlusion detector is configured to operate at a lower depth resolution than the bundle caster (fig. 6).

Claims 23 and 24, Lathrop does not teach occlusion technique; however, Greene et al. teaches ray casting connects to occlusion, the occlusion detector comprises: a z-buffer configured to store an occlusion depth for each of a plurality of pixels (col. 3, lines 56-61), the occlusion depth being a low resolution representation of pixel depth (z pyramid; col. 3, lines 61-67; col. 5, lines 45-67); a register configured to receive a pixel set descriptor describing a set of pixels including a minimum depth for the set; and a comparator configured to access the z-buffer and compare the minimum depth with the occlusion depth for each pixel within the set of pixels (col. 10, lines 45-67). It would have been obvious to one of ordinary skill in the art at the time the invention was made

to incorporate the z buffer as taught by Green into the ray caster of Lathrop's system, because using ray casting and z buffering, it would improve visibility algorithm in order to significantly speed up the rendering of 3D scenes (col. 3, lines 49-52).

Allowable Subject Matter

8. Claims 6-10 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

Claims 6-10, the prior art does not teach subdividing the ray bundle into child bundles when the bundle proximity test is positive; traversing and subdividing until each child bundle is a single ray; partitioning along the largest ray bundle dimension; partitioning along each ray bundle dimension; combining child bundles of a subdivided ray bundle when the proximity test of the ray bundle is negative.

9. Claim 14 is allowed.

The following is a statement of reasons for the indication of allowable subject matter: Claim 14, the prior art does not teach retreating a second casting distance and subdividing the ray bundle into child bundles when the bundle proximity test is positive; advancing, subdividing and retreating until each child bundle is a single ray.

Response to Arguments

10. Applicant's arguments with respect to claims have been considered but are moot in view of the new ground(s) of rejection.

The rejections of claims have been modified in this Office Action.

Applicant argues that Kaufman and Lathrop references do not teach recursive ray bundle casting. Examiner respectfully disagrees with the argument, because Kaufman teaches "a more complex and realistic method of scene visualization is called ray tracing". Ray tracing involves projecting plurality of families of 3D discrete rays (col. 1, lines 24-26; col. 2, lines 40-68), and Lathrop teaches this feature in fig. 2 which shows plurality of rays are tracing.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Kimbinh Nguyen** whose telephone number is **(703) 305-9683**. The examiner can normally be reached **(Monday- Thursday from 7:00 AM to 4:30 PM and alternate Fridays from 7:00 AM to 3:30 PM)**.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Zimmerman, can be reached at (703) 305-9798.

Any response to this action should be mailed to:

Commissioner of Patents and Trademarks

Washington, D.C. 20231

Or faxed to:

(703) 872-9306 (for Technology Center 2600 only)

Hand-delivered responses should be brought to Crystal Part II, 2121 Crystal Drive, Arlington, VA, Sixth Floor (Receptionist).

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Technology Center 2600 Customer Service Office whose telephone number is (703) 306-0377.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

May 10, 2004

/Kimbinh Nguyen/

Kimbinh Nguyen

Patent Examiner AU 2671